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LESIONS OF THE SACRAL AND LUMBAR PLEXUSES.

*With Remarks on their Importance, and their Diagnosis,
General and Localizing.*¹

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THE purpose of the present paper is to show the importance and comparative frequency of lesions of the limb plexuses, to give some suggestions or rules for their recognition, and briefly to refer to questions connected with their surgical treatment. Gross lesions, not degenerations, will be considered; and so-called functional affections, such as neuralgias proper, will be treated of only as necessitated by a discussion of diagnosis. Some of the lesions of the limb plexuses or their cords or branches are common to all, as, for example, neuritis, neuromata, non-neural growths implicating nerves, aneurisms, abscesses, gunshot and other injuries. Other gross lesions have a special character owing to location: as rectal, ovarian or uterine lesions involving the sacral; vertebral caries and certain abscesses the lumbar, and dislocations of the shoulder or fracture of the clavicle, the brachial plexus. It will be impossible in the space to which this communication must be restricted to dwell at length upon

¹ Read before the Neurological Section of the New York Academy of Medicine, May 10, 1889.



fine points of localization; but specifically in a few instances and incidentally in others, localizing facts and rules will be given. Complicated as is the sensory and motor arrangement and distribution of these plexuses, thanks to the careful work of Mitchell, Paterson, Goodsir, Ferrier, Bert and Marcacci, Forgue and Lanagrace, Walsh, Putnam, Herringham, Ross, Thorburn, and a few others, we are now able to approach the subject of the localization of lesions of even particular cords of these plexuses and their nerve roots with increasing confidence.

LESIONS OF THE SACRAL PLEXUS.

The sacral plexus formed by the lumbo-sacral cord, the anterior divisions of the three superior sacral nerves, and a part of the fourth, rests largely upon the surface of the pyriformis muscle in the true pelvis; and a single glance shows how thoroughly, in accordance with its great function, it is protected both by its position and coverings.

It may be well to recall one or two well-known points in pelvic neural anatomy which may have some localizing value. The superior gluteal nerve, for instance, arises from the back part of the lumbo-sacral cord, and is the only nerve that springs from that important link between the lumbar and sacral plexuses; so that a lesion strictly limited to this cord would give sensory and motor impairment in the distribution of this nerve, as well as the symptoms resulting from interference with the functions of the lumbo-sacral cord itself. The muscular distribution of the superior gluteal is to the gluteus minimus and medius and tensor vagina femoris. The lowest of the intra-pelvic nerves are not connected with the sacral plexus at all. These are the branches of the fourth and fifth sacral nerve roots to the levator ani, sphincter ani, coccyx, and skin

of these parts. A lesion may be so isolated as to affect only these extra-plexal pelvic nerves, or the plexus may occasionally be affected and these nerves escape.

The neurologist should know the landmarks for examining and palpating the sacral plexus and intra-pelvic nerves by the rectum, the chief of which are the great and lesser sacro-sciatic ligaments, the spine of the ischium, and the pyriformis muscle.

A few general statements with reference to lesions of the sacral plexus may serve to present the subject more clearly and comprehensively. A lesion of the sacral plexus in its entirety will strongly counterfeit a unilateral affection of the lumbo-sacral portion of the spinal cord from which the nerves of the plexus arise, or of the lower part of the cauda equina within the spinal canal. Bilateral lesions of the sacral plexuses so closely counterfeit lesions of the lumbo-sacral region of the spinal cord, or of the cauda equina, as to make the diagnosis sometimes exceedingly difficult; and in some cases of this kind the differentiation can be best made by proper local manipulation and examination by the rectum or vagina, or both. Lesions of single or several cords of this plexus, or of its nerve branches within the pelvic cavity, may counterfeit neuralgias of the nerves in either their intra- or extra-pelvic distribution; sciatica is a frequent diagnosis in these cases. Lesions of the sacral plexus or intra-pelvic nerves are not infrequently supposed to be disease of the uterus or ovaries, or their appendages and surroundings; and, on the other hand, disease and enlargements of these parts often involve the plexus.

Beside growths or other diseases of the uterus, ovaries, and their connected parts, the gross lesions which may affect the sacral plexus, or in which it may be implicated indirectly, are neuritis or nerve degeneration from pressure or bruising during labor,

rectal disease, pelvic cellulitis and abscesses, pelvic or intra-pelvic tumors, particularly neuromata, osteomata, and osteo-sarcomata, gunshot wounds, and neuritis, unilateral or bilateral, of unknown cause.

Psoas abscess may follow such a course as to involve the sacral plexus, and, before taking up the special lesions of the plexus, I may dismiss this point with a few words. Psoas abscess tends often to follow an irregular or multiple course. The pus may pass down the sacrum; it may even leave the pelvis by the sciatic notch. Brodie¹ records a case in which the abscess descended from the loins and presented as a tumor in the groin. Suddenly the tumor disappeared, but later a large collection of matter was found in the posterior part of the limb, behind the little trochanter of the femur. Post-mortem examination showed that the abscess had taken the course of the common tendon of the psoas magnus and iliacus internus muscles to their insertion into the bone, afterward extending further backward below the inferior edge of the quadratus femoris. A number of cases have been recorded in which this complication has occurred. Thompson² has, for example, reported a case of psoas abscess which was supposed for months to be one of sciatica. Pain, terrific but remittent, followed the course of the great sciatic nerve of the right leg. It sometimes extended to the ankle and even to the dorsum of the foot and great toe. Tenderness on pressure, hyperæsthesia in some parts and anæsthesia in others were among the symptoms.

One form of puerperal paralysis is probably the result of pressure upon the sacral plexus, or upon the lumbo-sacral cord where it passes over the brim of the pelvis; more probably the former, as the

¹ Diseases of the Joints.

² Lecture on Sciatica, in a Series of American Lectures, edited by E. C. Seguin, M.D.

lumbo-sacral cord is particularly well protected in its descent. Few such cases, however, have been recorded. Imbert-Gourbèyre,¹ in his monograph on *Puerperal Paralysis*, speaks of several cases in which, from prolonged labor, and probably also from imprudent obstetrical manipulations, paralysis resulted. One of these cases, cited from Rademacher, was an incomplete and painful paraplegia coming on at the end of a long and difficult labor, and cured in eight days chiefly by friction. Another patient, thirty-six years old, during her third labor was paralyzed in both extremities, and recovered in a few months. Salvat is cited as reporting the case of a woman treated by him for vesico-vaginal fissure, with paraplegia, produced by the long stay of the head of the foetus in the inferior strait. Another patient, thirty-two years old, during her fourth labor, which was prolonged and the delivery by forceps, suffered great pain in the loins, accompanied by feebleness and swelling of the legs. The feebleness increased to paraplegia, and she had lancinating pain, paræsthesia, and cramps in the limbs. These cases are imperfectly reported, and, as the neural symptoms were bilateral, it is possible that some of them may have been spinal. It is, however, more likely that they were due to direct traumatism of the lumbo-sacral plexuses. Dr. Dercum, of Philadelphia, has reported to me, verbally, some particulars about a case of unilateral paralysis, atrophy, and anæsthesia of the leg following delivery, and apparently due to pressure on the sacral plexus in the floor of the pelvis.

Dr. Howard A. Kelly, Associate Professor of Obstetrics in the University of Pennsylvania, has kindly furnished me with brief notes of two interesting cases supposed for a long time to have been

¹ Mém. de l'Académie roy., vol. xxv.

purely gynecological. The first case, Mrs. X., had passed through a difficult instrumental confinement some twelve years before coming under observation. She visited many prominent gynecologists, and underwent a number of operations, the last being the removal of two large tubes and the ovaries. She was relieved of menstrual exacerbations, but still suffered great pain in the pelvis, for which she was receiving galvanism, massage, and anti-lithic remedies. Her suffering continued unabated; and Prof. H. C. Wood, in whose charge she was, called Dr. Kelly in consultation. A careful examination showed that the uterus and its surroundings were perfectly free from disease. On making a careful rectal examination, however, outlining the sacro-sciatic ligament and pyriform muscle, and carefully palpating the roots of the great sciatic nerve, upon touching one cord she gave a sudden scream, at the same time doubling up her leg and jerking her body in bed. Here, directly over the roots of the left sciatic nerve—the left sacral plexus—was the only diseased area which could be detected in the pelvis. All subsequent treatment was directed to this condition.

In a second case the patient had constant pelvic pain, which she described more as a soreness, and located “back of her womb.” She had been for several years since the birth of her last child under the care of gynecologists, who had not been able to give her any relief whatever. It was found by exploration that the only point of tenderness in the pelvis was at the roots of the sciatic nerve, and here she at once located all her pain, when the doctor introduced his finger into the rectum and made pressure on the nerve trunks. The case was one of neuritis. As Dr. Kelly remarks in the communication sending the notes of these cases, they teach the

value of exploring the pelvis outside of the uterus and its annexes.

In one interesting case of railroad injury, supposed to be an example of railroad brain and spine, careful examination showed exquisite tenderness over both sacral plexuses, but particularly marked on one side. The plexuses were palpated through the rectum. This patient suffered great pain and tenderness in the lumbar and sacral and sacro-ischiatic regions and also complained of general weakness and pains in the lower extremities. She was pregnant at the time the accident occurred, and suffered greatly later at the time of her labor, the child dying during parturition. She had other cerebral and general nervous symptoms.

In rare cases of extensive disease of the rectum or of immense fecal accumulations, the sacral plexus or some of the intra-pelvic nerves may be compressed or irritated, or both, and thus give rise to great suffering. Pelvic cellulitis may occur even in the male, and also give symptoms of irritation and of compression of the sacral plexus. Skjeldrup¹ describes such a case in a man fifty years old, in which examination per rectum showed a hard tumor. Muir, quoted by Skjeldrup, has published a similar case. Mitchell² speaks of a case in which the patient suffered from numbness in the left foot and leg, followed by increasing loss of power to flex the foot. The peroneal muscles were found to have lost electrical response. On vaginal examination she was discovered to have a large growth behind and to the left of the womb. Innumerable cases of pelvic cellulitis in the female are of course on record, but in few have the sensory, motor, and other neural symptoms been reported with sufficient care to

¹ Tidsskrift f. Prakt. Med., quoted in Medical Register, vol. iv., September 15, 1888.

² Injuries of Nerves.

allow of anything but a general diagnosis. If gynecologists paid strict attention to the exact distribution of the pain in their cases of pelvic inflammation, abscess and growths, they would have a surer hold on early diagnosis. The character of the pain in these cases usually receives fuller attention than its distribution as would be naturally expected.

It is well known that neuromata occur somewhat frequently in connection with the cords or branches of the brachial plexus. Doubtless these growths now and then are present also in both the sacral and lumbar plexuses, and are overlooked. I have not been able to find reports of such cases, but it is probable that occasional rare forms of intractable sciatica, or other forms of neuralgia of the lower extremity in the distribution of some of the sacral nerves, are due to growths of this character.

Putnam¹ has reported an instructive case of sarcoma involving the intra-pelvic nerves, notes of the autopsy being given. The first and a recurring symptom was pain in the middle toe of the left foot. In six months the sacral region became extremely painful, and also the posterior and outer surface of the thigh, and the outer side of the leg and foot. The pain was accompanied by some paræsthesia, especially in the outer half of the left foot.

The right leg was attacked with severe pain, confined to the posterior and outer side of the thigh, nearly six months after the left. The pain abated, and renewed itself in the left leg. Walking became difficult. The muscular weakness affected not only the muscles of the sciatic distribution, but also the quadriceps extensor, and the psoas and iliacus. Slight tactile insensibility was present in the vicinity of the anus. Applications of galvanism were very painful. Knee-jerk was absent on both sides.

¹ Journ. Nerv. and Ment. Dis., vol. xiv., Sept. and Oct. 1887, p. 601.

No tumor could be discovered by rectal examination.

I have seen several cases of intra-pelvic or pelvic growths, causing pressure upon the sacral plexus or involving some of its cords or branches. In one an autopsy confirmed the diagnosis.¹ A man who had been treated for many months for sciatica, had pain chiefly down the back of the thigh, in, but not strictly confined to, the line of the sciatic nerve. The pain was altogether in the right leg; it was increased by pressure and movement, and he could not bring the foot firmly on the floor. A marked symptom was swelling of the leg, the left thigh measuring thirteen and a quarter inches; middle of leg fifteen inches; ankle eight inches; the right thigh twenty-one and a half inches; middle of leg fourteen inches; ankle nine and a half inches. The thigh presented a solid œdematous condition, with distinct pitting on pressure. A tendency to outward rotation was present. Pressure at the sciatic notch seemed to produce more pain than pressure elsewhere in the leg. Some of the abdominal muscles of the right side were cramped and tense, although those of the left side were relaxed. Movement of the limb caused pain. Examination by the rectum showed distinctly a solid resisting growth on the right side. In another case the diagnosis of sciatica had been made and persisted in for many months, but examination by the rectum revealed a tumor. The nerves of nearly the entire sacral distribution were involved, but very irregularly, in pain, anæsthesia, paralysis, and atrophy. In still another case, at the Philadelphia Hospital, the patient was also treated for a long time for sciatica, but close examination demonstrated disease of the acetabulum, and after death a large osteo-sarcomatous growth was

¹ Three of these cases were briefly referred to at the meeting of the American Neurological Association, 1887.

found. Miles,¹ of Baltimore, has contributed a case of malignant disease of the pelvis which was supposed to be one of sciatica. The patient developed a malignant tumor about the hip, of which he died. Examination both externally and by the rectum revealed nothing. The one great symptom was pain in the sciatic distribution. One important practical point is that all of these cases had been treated for other affections, chiefly for sciatica or spinal disease.

A few interesting gunshot wounds of the sacral plexus have been reported, and many other cases equally interesting of rectal and pelvic gunshot injuries in which the nerve cords escaped. Habgood² has recently reported a bullet wound of the pelvis involving the rectum, in which, under antiseptic treatment, the patient rapidly recovered. This patient suffered great pain, not closely described as to its particular distribution. The bullet passed inward through the great sacro-sciatic notch. During the American war 103 cases of gunshot wounds are reported, of which 44, or 42.7 per cent., proved fatal. One case of gunshot wound of the sacral plexus is reported in vol. ii., *Medical and Surgical History of the War of the Rebellion*, p. 341. The patient, a private, aged twenty-three years, was wounded at Gettysburg. He was treated on the field until August 21st, and then admitted to Camp Letterman Hospital. Acting Assistant Surgeon H. H. Sutton reported that a ball from a Sharp's carbine entered the left side of the sacrum at the third segment, passed into the pelvis and there lodged. The ball in its passage injured the sacral plexus, consequently the leg of the corresponding side became paralyzed,

¹ Journ. Nerv. and Ment. Dis., vol. xiv., Sept. and Oct. 1887, p. 666.

² Manitoba, Northwest and British Columbia Lancet, 1887-8. Also Brit. Med. Journ.

but the natural feeling and movements of the limb were gradually returning when the patient was admitted. Unfortunately, a study of this case as to sensation and motion was not made or not recorded.

On general principles I can see no reason why neuritis of the sacral plexus, either spontaneous, rheumatic, infectious, or of unknown cause, may not occur with moderate frequency. Neuritis of the brachial plexus, either in its entirety or in some of its subdivisions, is a well-known and often investigated disease; but the sacral and lumbar plexuses seem to have rarely attracted the attention of physicians with the idea that they were the subjects of neuritis. The surroundings of the sacral plexus are such as to render it more liable than the brachial to inflammation, either by contiguity or by causes acting through its environment. It is, perhaps, less liable to rheumatic inflammation. In every obscure case of unilateral, or even bilateral, pain in the extremities, whether associated with anæsthesia and paræsthesia or not, the sacral plexuses should be carefully examined by palpation through the rectum. A word of caution is perhaps here necessary. In some individuals, particularly females, of a highly nervous temperament, it is possible that pressure upon the comparatively exposed intra-pelvic nerves, reached by the finger in the rectum, may give rise to pain, which by psychical influence will be exaggerated so as to mislead the physician into supposing that the nerves are in a state of inflammation when such is not the case.

The following cases described by Dr. L. C. Gray¹ are cases in point where a rectal examination might have been of service for diagnosis.

The first patient felt tingling pains through both buttocks, the perineum, the scrotum, the tip of the

¹ Journ. Nerv. and Ment. Dis., vol. xiii., 1886, p. 743.

penis, and down the back of both thighs, with some smarting in urination. As the result of the Turkish and Russian baths these symptoms were violently augmented and high fever ensued. Sexual desire was entirely lost, as were also the skin and cremaster reflexes. The patient was sent to the country and had a violent attack of supra-orbital neuralgia, after which he recovered.

The other case was a woman, thirty-five years old, who was suddenly attacked with sharp pain in the buttocks, perineum, labia, and down the back of the thighs to the knees, with simultaneous retention of urine. Vesical anæsthesia came on later, but no motor impairment. Over the area of pain was also impairment of the senses of touch, temperature, and pain, but slightly less near the knee than above.

These cases are sufficient to show the importance of the subject and the frequent actual occurrence of the forms of lesions involving the sacral plexus or other intra-pelvic nerves.

Let us briefly consider the main points in the diagnosis of such cases. In the first place, the great value of close examination by the rectum, which has already been dwelt upon, cannot be over-rated. Another important general point is as to the unilateral or bilateral character of these affections. They are commonly unilateral, or begin on one side, and, in exceptional cases, become bilateral. In some cases, however, of spontaneous neuritis, or pressure neuritis, or palsy, as in those reported by Imbert Goubéyre, the symptoms may be nearly uniformly bilateral.

Large compressing and destructive lesions of the sacral plexus give nearly the same syndrome, only usually unilateral, as is presented by lesions of the lower part of the cauda equina. These symptoms, of course, vary somewhat according to the amount

of nerve involvement. They are pain variously distributed in the domain of the sacral nerves—in the buttock, backs of the thighs and legs, soles of the feet and outer sides of the feet; anæsthesia, analgesia, and paræsthesia in the distribution of the nerves, from the second sacral nerve down to and including the coccygeal; paralysis and wasting particularly in the muscles below the knee, nearly all of which are in the sacral distribution; and in those muscles above the knee which occupy the distribution of the great sciatic and gluteal, small sciatic and superior gluteal nerves; trophic disorders, such as bedsores, perforating ulcers, abscesses, joint and bone changes, etc.; and vaso-motor affections, such as changes in surface temperature, flushing, pallor, sweating, œdema, priapism, and coldness of the extremities. The bladder and rectum will be involved when the lowest sacral nerves are implicated—the nerves which do not strictly belong to the plexus. Reactions of degenerations will be present in most of the paralyzed muscles. Knee-jerk, ankle clonus, and the plantar reflex are likely to be absent on both sides; the cremasteric reflex as likely to be retained. The symptoms enumerated for lesions of the cauda equina are, in nineteen cases out of twenty, bilateral, although often not absolutely symmetrical. Consider now the same symptom-picture in one limb, and we have the phenomena produced by a large irritating, compressing, and destroying lesion of the sacral plexus.

Thorburn's¹ commentary on one of his cases of cauda equina lesion might, if the symptoms were not bilateral, be almost equally applicable to a pelvic plexus lesion. He says of this case that there was sensory paralysis of all the nerves of the sacral plexus, and possibly of the obturator, but not of the

¹ Brain, January, 1888.

anterior crural or other lumbar nerves; the perineum, penis, scrotum, and urethra, being supplied by branches of the pudic, were anæsthetic, but the root of the scrotum retained sensation, owing to the presence of twigs of the ilio-inguinal nerves, which, however, only descend to a very short distance. Paralysis with the reaction of degeneration was complete in the muscles supplied by the nerves of the sacral plexus. Those supplied by the anterior crural, although presenting the reaction of degeneration, were only weakened, and the adductors, supplied by the obturator, appeared also to retain some power. Cremasteric reflex remained, but below this point reflex action was lost.

Unilateral lesions of the sacral network must be occasionally differentiated from unilateral affections of the cauda equina. Usually, of course, cauda equinal symptoms are bilateral; but if the lesions are hemorrhagic, inflammatory, or from injury, they often are not symmetrically bilateral, and rarely they may be unilateral as in a case described by Erichsen, and quoted by Thorburn. It is, indeed, doubtful whether this case, which recovered under four months' treatment, was not, after all, one of rheumatic or traumatic neuritis of the sacral plexus. The patient could not stand but could move his legs in bed; he had not complete paralysis except in the peronei and extensors of the left ankle; rapid wasting of the left leg came on; numbness and tingling were present on the outer side of the left thigh, and partial loss of sensation below the left knee. The right limb was normal, he had occasional loss of control over the sphincters, and coldness of the extremities, especially of the left foot. The case was due to injury and came on gradually during ten days. Tenderness over the third lumbar vertebra was present after the tenth day, and symptoms of cervical injury were also present.

Weir Mitchell has given some diagnostic rules for the separation of spinal and cerebral from nerve lesions. Evidently, however, these are applicable only to the separation of true spinal cord lesions from lesions of the spinal nerves whether within or outside of the spinal canal. In other words, he has not made any distinction between lesions of the cauda equina within the canal and those of the plexuses in the abdominal and pelvic cavities. With our present lights we have little difficulty in differentiating lesions which involve the spinal cord itself from peripheral lesions. A much greater difficulty, as just indicated, is that which arises in separating irregular lesions of the extreme lower part of the cauda equina from lesions, particularly bilateral lesions, of the plexuses outside of the spine.

In cases of extensive bilateral lesions of the abdominal or pelvic plexuses, supposed to be cases of traumatic myelitis, the points mentioned by Mitchell might be of some service. He speaks, for instance, of a plan proposed by Stich.

"When cutaneous anæsthesia exists," he says "it is often easy to learn whether its cause lies in the nerves or in the central organs by following this plan. If the insensible region can be made the point of departure of reflex movements, the anæsthesia is of central birth, because to have reflex motion an excitation must have reached the spine, by which we infer healthy nerves, while the mere presence of anæsthesia will in this case indicate the existence of disease in the spine above the point which is the seat of the reflex power exhibited. If the proof be negative, and if the excitation cause no movement, we can arrive at no definite conclusion until, following the same sensitive nerve up the limb, and by seeking to excite it through its reflex acts, by touching the skin with a hot sponge or ice at successive points, we learn if at any upper portion of the tegument we can produce this result. Should we get an affirmative reply, we may presume that the anæsthesia is of peripheral origin. When, finally, the answer is negative up to the spine itself we learn nothing by this method, the total absence of all reflex move-

ment being equally compatible with either loss of conducting power in the peripheral trunks and branches or with extensive alteration of spinal centres. The value of this means must be necessarily limited by the difficulty of exciting reflex acts from all regions of the skin." (*Injuries of Nerves.*)

Of another point which has, I think, but limited application, or is of doubtful value, Mitchell writes as follows :

"There is another peculiarity which separates all extra-central nerve lesions from cerebral, and also from spinal disease ; but I do not feel that as yet it is available to any large extent. I noticed some years ago that in even the gravest lesions of nerve trunks, if a touch were felt at all, it was felt with no remarkable delay ; while in many central palsies, if severe, and especially in such as result from extensive spinal malady, the time required for transmission to the sensorium was, as Cruveilhier pointed out, very largely increased—so much so, indeed, as to be readily estimated in a rough way by the hand of a watch beating quarter seconds, or still better by a metronome. The cause of this difference is still obscure to me, nor is it easy to see why diffuse sclerosis, for example, should so retard a sensory impression, while injured nerve fibres have no such effect."

Certain intra-pelvic neuralgias must be distinguished from neuritis or other lesions of the sacral plexus and intra-pelvic nerves. It is a question whether some of the cases reported as examples of neuralgia have not been rather forms of neuritis. Mitchell,¹ under the name of "Anal and Perineal Neuralgia," reported several interesting cases of this kind. This disorder, as described by him, is a painful affection of the anal and perineal regions, accompanied or not, as the case may be, with spasmodic contraction of the anal muscles and of those of the perineum. It is met with in locomotor ataxia, and also as an isolated affection usually following masturbation or sexual intercourse. It is likely that in these cases examination by the rectum

¹ Philada. Med. Times, vol. iii., July 19, 1883, p. 659.

would show tenderness over the anal and perineal nerves. Treatment by rest and anodyne suppositories is most useful, and points also to the probable neuritic character of the affection.

LESIONS OF THE LUMBAR PLEXUS.

One of the commonest and most misleading affections involving the lumbar plexus is that compound lesion to which I have already referred, usually described under the comprehensive term psoas abscess. Eleven years ago I called attention to the frequent simulation by it of certain special forms of nervous affection, painful, paralytic, and spasmodic;¹ and, of course, the subject has been frequently written about, both before and since. Still, mistakes are constantly being made; and the subject is of considerable importance to neurologists. In one of my cases the diagnosis of crural neuralgia had been made, and no abscess was suspected. Pain most severe distally extended from Poupart's ligament to the inner side of the knee, along the course of the anterior crural nerve and its internal saphenous branch. This pain was relieved by sitting, or lying, or flexing the thigh on the pelvis, at the same time keeping the knee bent. A partial paralysis, or pseudo-paralysis, of the ilio-psoas muscles was present, the patient being compelled to lift the leg with his hands in order to cross the knee.

In another case on which I made an autopsy, the patient died three years after his initial symptoms, having been, in the meantime, the victim of numerous and diverse diagnoses, such as lumbago, sciatica, rheumatism, and paralysis from spinal exhaustion. His first symptom was severe pain in the lumbar region, which later extended down the right hip, and still later down the inner aspect of the

¹ Trans. Med. Soc. Pennsylvania, 1878.

thigh. He became unable to walk without support in eighteen months. It is not necessary to describe his progressive symptoms in detail. Later, he carried his body flexed upon the thigh, and both legs were wasted, the right more than the left. A significant fact was the absence of implication of the bladder and rectum, showing that the ano-vesical nerves, which arise from the conus and are distributed to the sacral rather than to the lumbar plexus, escaped. An accurate localizing study of this case, in its initial period, would probably have indicated its true nature; and operation performed early, after the method recommended by Treves and others, might have saved the life of the patient.

In one historical surgical case,¹ that of President Garfield, a quick appreciation of the symptoms produced by irritative lesions of separate cords of the lumbar plexus, and of the lumbo-sacral roots, was of considerable service in reaching a conclusion as to the exact course taken by the bullet. This case is also probably a study in intra-spinal nerve-root localization and worthy in this connection of our passing attention. Studying its abundant literature I find somewhat differing statements as to the nervous symptoms presented. The question whether the subjective symptoms presented sufficient facts for diagnosis was argued pro and con. with much warmth in some of the medical journals. One report states that the President suffered pains of a symmetrical character in both feet; another that hyperæsthesia was always more severe in the right than in the left foot and extended up the leg to some distance, and it was far more intense upon the dorsal

¹ Among the contributions discussing this case are the following: Official Report—*Amer. Journ. Med. Sci.*, Oct. 1888; White—*MED. NEWS*, vol. xl., No. 25, June 24, 1882; Bliss—*Med. Rec.*, Oct. 8, 1881; Walsh—*Walsh's Retrospect*, Oct. 1888; Baker—*MED. NEWS*, vol. xli., No. 5, July 29, 1882.

than upon the plantar surface. The different contributors to the controversy all, however, agreed that hyperæsthesia was present on the right side of the scrotum, differing only as to whether it also extended over the lower abdominal region. The pointing was clearly to injury of the right ilio-inguinal, and probably also of the right ilio-hypogastric nerve, or their common trunk, as these nerves are both derived from the first lumbar root, and as a frequent position for this root is almost exactly where the ball entered the lumbar vertebra.

The ground has been taken that the cause of the symmetrical, or at least bilateral, pains in the feet was central, and therefore due to a lesion by jarring or concussion of the spinal centres opposite or near the vertebra perforated by the bullet. The terrific jarring of the spinal column by the concussion of the bullet was amply sufficient to have caused minute extravasations at the origins of the last lumbar and upper sacral nerves, which may have so irritated the roots of these nerves as to have caused bilateral pains in the distal portions of the lower extremities. The sensory nerves for the feet on both the posterior and anterior surfaces are derived from the sacral plexus; with the exception of the long or internal saphenous nerve, a branch of the anterior crural derived from the third and fourth lumbar roots. Within the spinal canal the nerves which go to form both the lumbar and sacral plexuses arise in a vertical extent of the cord which is very short, and is mainly opposite to the last dorsal and first lumbar vertebrae. It is significant that the roots of the first, second, and third sacral nerves are almost exactly opposite the upper part of the first lumbar vertebra where it was perforated by the bullet. The phenomena presented seem to admit of no other reasonable explanation. A crushing or destructive lesion of the lumbo-sacral region of the spinal cord

was out of the question, as such a condition of paralysis, atrophy, anæsthesia, vaso-motor and trophic disturbances, and interference with the functions of the bladder and rectum, would have been present as could not have deceived.

True lumbo-abdominal neuralgia is comparatively rare, and, therefore, in cases of lumbo-abdominal pain, whether joined with crural pain or not, we should carefully inquire for local lesions of the lumbar plexus, as aneurisms, abscesses, neuritis, etc. A close study of such a case will often reveal its true nature. Lumbo-abdominal neuralgia, as stated by Erb, is commonly associated with intercostal. The presence of marked motor and anæsthetic disturbances with certain vesical, rectal, and sexual symptoms will help to decide against true neuralgia and in favor of lumbar plexus disease, if the affection is unilateral. Many of the cases of so-called lumbar, sacral, abdominal, lumbo-abdominal, and other forms of plexic neuralgias are in reality cases of neuritis of these plexuses.

Certain affections which involve some of the cords or branches of the lumbar plexus, particularly abscesses—lumbar, iliac, psoas, and perinephritic—have not infrequently been wrongly supposed to be other diseases. Lydston¹ has reported a case in which acute lumbar abscess simulated at its beginning nephritic colic. A young man, aged nineteen, who had been previously healthy, awoke suddenly one morning with a severe pain in his right ilio-lumbar region, doubtless due to implication of the upper lumbar nerves. This pain had persisted for the entire time prior to his visit, and had been but imperfectly relieved by morphia. In view of the history and physical condition of this case, a diagnosis of renal calculus—probably impacted in the

¹ Medical Register, vol. iv., September 8, 1888.

ureter—was made, as, according to the patient's statements, the location of the pain had gradually descended toward the right iliac fossa. The usual line of treatment for the condition which was supposed to exist was ordered, but later a large abscess pointed in the back to the right of the spine, between the ribs and the crest of the ilium.

An available knowledge of the segmental distribution of sensory nerves in the trunk and extremities may be of considerable service in diagnosing lesions of the sacral and lumbar plexuses, even at an early period. Pain, anæsthesia, and paræsthesia are often experienced in these cases in special peripheral areas, as illustrated in the case of President Garfield, and in the pelvic tumor reported by Dr. Putnam, to which reference has been made. In Putnam's case the first and a recurring symptom was pain in the middle toe of the left foot, and subsequently, other symptoms were paræsthesia of the dorsum of the foot, and later of the outer side of the leg and the posterior aspect of the leg and thigh. These symptoms definitely indicated involvement of sacral nerve cords. The only portion of the foot which escaped was the inner side and great toe supplied by the long saphenous nerve, a branch of the lumbar plexus. The sensory symptoms and the particular order of their occurrence fairly indicated the particular method of the progressive involvement of the nerve cords and branches of the sacral plexus. Pain in cases of lesion of the nerve roots, either in their intra-spinal course or in the plexuses, is often projected to distal portions of the sensory nerves, and a close study of the distribution and progress of this pain will lead to a diagnosis of the location of the lesion producing it.

The question of operation for certain lesions of both the sacral and lumbar plexuses is one of some practical interest. It is probable that trephining the

pelvis could be performed successfully in a few cases for lesions of the sacral plexus, such as abscess and removal of intra-pelvic growths, or excision of parts or the whole of the plexus. This could, probably, be best done by entering the pelvis from the median line above and behind ; but I leave the question of the best place and method of operation for the consideration of surgical anatomists, simply suggesting its performance for some of the lesions discussed in this paper. In gynecological surgery several intra-pelvic operations by the sacro-coccygeal route have recently been reported ; and this plan of operation has received the indorsement of distinguished German surgeons. It has been employed for pelvic abscess, for disease of the ovaries and Fallopian tubes, and for extirpation of the uterus. The lumbar plexus, in part of its course, can be reached by operation through the back.

